DRAFT

California Environmental Protection Agency

Air Resources Board

Review
Of
Gasoline Cargo Tank Truck
Pressure Performance
Test Procedures

MONITORING AND LABORATORY DIVISION VAPOR RECOVERY IN-USE PROGRAM SECTION

DATE: March 19, 2008

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AIR RESOURCES BOARD Monitoring and Laboratory Division

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I. <u>SUMMARY</u>

This review was initiated in response to a letter, dated June 19, 2007, from Jay McKeeman, Vice President of Government Relations and Communications of the California Independent Oil Marketers Association (CIOMA) to Jim Ryden, Chief of the Enforcement Division (ED) of the California Air Resources Board (ARB). The letter was a formal request to submit the ARB gasoline cargo tank certification and test procedures to an independent third-party evaluation. In the letter, CIOMA expressed concerns with the consistency of the procedures. Specifically, CIOMA mentioned that a primary problem is that cargo tanks are tested by ARB in the field and when they return to the repair shop or certified testing location the failure cannot be repeated.

In response, staff of the ARB Monitoring & Laboratory Division (MLD) reviewed the procedures and observed tests conducted by ED during the period of August 20, 2007, to November 15, 2007. During this review period, ED identified and cited 40 cargo tanks which were found to exceed the leak rate standard. Of these, MLD staff was able to accompany 14 of the tankers along their delivery routes to the repair facility. In all but one of these observed cases, the repair facility found the same leaks as ED, when no intervening repair work was accomplished before diagnostic testing by the repair facility.

MLD staff has concluded that the test procedures conducted in the field by ED are an accurate means of determining leaks and repair facility's testing procedures, as written, are effective in discovering the source of the leak and verifying that the tank is repaired and ready to return to service. Furthermore, recommendations are made regarding training for independent testers as well as further study into problematic components and degassing operations.

II. INTRODUCTION

There are three ARB test procedures to determine the performance of cargo tank vapor recovery systems. These procedures, TP-204.1, TP-204.2 and TP-204.3, are available at the following website: http://www.arb.ca.gov/testmeth/vol2/new2006vol2.htm

TP-204.1, Determination of Five Minute Static Pressure Performance of Vapor Recovery Systems of Cargo Tanks, is the required test for annual certification. Additionally, this test is required following repairs conducted as a result of a Notice of Violation (NOV) issued by the ARB ED, prior to returning the cargo tank to gasoline service. The test is conducted on an empty cargo tank, free of gasoline vapors, using compressed air and a vacuum source. The test is conducted by the owner/operator, a repair facility, or an independent tester and has three main performance elements:

- 1. Static pressure performance, positive pressurization.
- 2. Static pressure performance, negative pressurization.
- 3. Internal vapor valve (IVV) performance, positive pressurization.

TP-204.2, Determination of One Minute Static Pressure Performance of Vapor Recovery Systems of Cargo Tanks, is the "daily" test conducted randomly by the ARB ED at gasoline bulk terminal loading racks. The test is conducted on a cargo tank immediately following loading using compressed nitrogen and has two main performance elements:

- 1. Static pressure performance, positive pressurization.
- 2. Internal vapor valve performance.

Note: If the pressure drops below ten inches water column in one minute during the static pressure performance test, the internal vapor valve is not tested.

TP-204.3, Determination of Leaks, is also a "daily" test conducted by ED at the loading rack. The test has two main performance elements:

- 1. Determination of vapor leaks.
- 2. Determination of liquid leaks.

III. <u>METHODOLOGY</u>

CIOMA expressed concerns with the test procedures' repeatability and consistency. In their estimation there are too many instances where there was a disparity between results obtained by ARB enforcement testing utilizing TP-204.2 and repair and retesting by industry utilizing TP-204.1. The current study was devised, in collaboration with CIOMA, to evaluate and compare results of these tests. The study began with three main objectives:

- 1. Determine the frequency that a cargo tank which fails to comply with the leak integrity standard at the loading rack will test compliant at the maintenance shop.
- 2. Identify the variables which may affect the reliability of evaluating cargo tanks for leak integrity.
- 3. Propose possible resolutions such as revising existing or developing new test methods, require training for all testers of cargo tanks, and proceeding with a third party review of the approach for testing cargo tanks.

Several key issues were identified prior to the start of the study:

- 1. Gasoline cargo tanks are subject to both an annual and a daily leak integrity standard.
- 2. The annual leak integrity standard, per TP-204.1, must be met once a year for renewal of the decal issued by ARB as well as following issuance of an NOV. The test is performed on an empty cargo tank which is free of gasoline vapor.
- 3. The daily leak integrity standard, per TP-204.2, is applied at any time to determine compliance. The test is performed on a tank loaded with fuel.
- 4. Cases have been reported where a tank is cited for failure to demonstrate compliance per TP-204.2 but subsequently meets the leak integrity criteria, without

- any diagnostic or repair work necessary, when tested at the repair shop after completing the delivery.
- 5. Industry has expressed frustration with the lack of repeatability/consistency of the test methods and has requested ARB to initiate a third party evaluation of the methods.
- 6 Can the internal vapor valve and pressure/vacuum vent valve be better designed to reduce test failures?

Prior to the start of the study, the following plan of action was proposed:

- 1. MLD will review the test methods utilized for determining the leak integrity of cargo tanks.
- 2. Staff of MLD Vapor Recovery In-Use Program and Quality Assurance Sections will accompany ED staff during compliance testing of cargo tanks.
- 3. For each non-compliant tank, MLD staff will witness and document the work performed at the shop to identify and repair leaks. Tanks which are found to be leak free at the shop will immediately be tested by ARB staff.
- 4. Quality Assurance staff will observe any testing of cargo tanks to assess weather or not the procedures are properly followed.
- 5. Prepare a report of findings which establishes the degree of the problem. Provide recommendations of what steps need to be pursued, if any, to improve the repeatability/consistency of the test methods used to determine leak integrity of gasoline cargo tanks.

During the initial deployment of the plan of action, a few changes were made for practical purposes. CIOMA was informed as the following changes were implemented:

- 1. It was not possible for MLD staff to follow each non-compliant tank through delivery and on to the repair facility to observe diagnostic and repair efforts. Efforts were made to maximize the number of non-compliant trucks followed by returning to the loading rack as soon as possible.
- 2. Even for trucks followed, it was not always possible to observe diagnostic repair work, due to variable operating hours at the repair facilities.
- 3. Depending on the type of leak detected at rack, some trucks were met at a later time or date for observation of repairs and retesting.
- 4. A Tank, if found to be leak free at the repair facility, would not be re-tested by ARB staff, but rather the re-test by the facility personnel would be observed by ARB staff, again due to time constraints.

The study spanned the time period of August 20, 2007, to November 16, 2007. During the course of this study, industry shared some other specific concerns. These included biases in the test procedures, calculation of ullage and leaks which go undetected at the loading racks, to name a few. These concerns were evaluated as they were brought to our attention.

The air districts included in the study were already on the ED schedule for that time period and covered the South Coast Air Quality Management District, the Bay Area Air Quality Management District, The San Joaquin Valley Unified Air Quality Management District, the Kern County Air Pollution Control District and the North Coast Unified Air Quality Management District.

IV. RESULTS

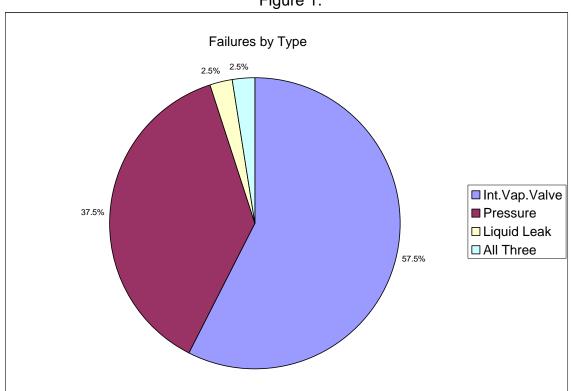
A total of 292 cargo tanks were tested by ARB ED at the loading racks, using TP-204.2 and TP-204.3, of which 40 failed to comply with the leak rate standard. Each of these 40 cargo tanks were cited by ED and issued NOV. Table 1 and Figure 1 provide a breakdown of the types of failures during the study period.

Note: "All Three" refers to a single cargo tank with a pressure leak, internal vapor valve leak and a liquid leak all at the same time.

Table 1. Failures by Type

		/ /
Failure type	Number	% of failures
Int.Vap.Valve	23	58%
Pressure	15	38%
Liquid Leak	1	2.5%
All Three	1	2.5%
Totals	40	100%

Figure 1.



Out of these 40 cargo tanks issued a NOV at the loading rack, MLD staff were able to follow 14 of them through their delivery cycle and on to the repair facility as described below in the daily observations. In just one case, the mechanic did not initially find the same leak, when there was no intermediate repair conducted on the tank. This was the October 17, 2007, Internal vapor valve violation. Furthermore, even in this case, the valve was replaced because it subsequently froze in the open position, in the presence of MLD staff, resulting in the leak being observed as detected earlier that day by the ED Staff.

The following excerpts are from the notes taken during MLD staff observations for each of the days of the study:

August 20, 2007 - Richmond, Chevron Terminal

- One violation, route, repair, and re-test were observed.
- A NOV for failure to meet pressure integrity was issued. Trailer could not be pressurized to 18 inches of water column (in.wc.).
- Repair was initiated prior to retest by the facility mechanic who met the driver at the Gasoline Dispensing Facility (GDF) and closed an open three inch camlock on top of the tank during product delivery.
- Degassing was conducted at the repair facility by loading with and subsequent unloading of diesel on site at the facility's own bulk plant.
- Additional repairs were conducted prior to conducting the TP-204.1 test. These consisted of replacing both camlock caps and gaskets with new equipment.
- Dramatic improvement in pressure integrity was demonstrated by the facility mechanic (i.e. the tank was able to be pressurized to 18 inch w.c., however final pressure after five minutes was 17.4 inch w.c.). The tank was still cooling down and the mechanic's intention was to re-test at a later time when temperature stabilized.
- Complete 204.1 test was not observed due to time constraints.
- Subsequent payment of the fine indicates the repair shop discovered vapor leaks.

<u>August 21,2007 – Richmond, Conoco-Phillips Terminal</u>

- One violation and route were observed.
- A NOV was issued for failure to meet the internal vapor valve leak standard on the cargo tank trailer.
- Upon return from the GDF delivery, the cargo tank was removed from service and parked at the repair facility located at the terminal of origin. The mechanic was gone for the day.
- Subsequently, we were informed that the repair would be conducted on August 24, 2007 at 0830 in Emeryville.
- No further activities were observed for this cargo tank.
- The test form returned to ARB by the repair shop identified maintenance was necessary to bring the tank back into compliance.

August 22, 2007 - Martinez, Shell Terminal

- One violation, route, repair, and re-test observed.
- A NOV was issued for failure to meet the internal vapor valve leak standard on the trailer.
- Following the delivery at the GDF, the cargo tank returned to the repair facility where the driver was instructed to return to the terminal for a partial load of diesel for the purpose of degassing.
- After loading diesel, the cargo tank returned to the repair facility where the diesel was unloaded into the facility's UST.
- The cargo tank was then parked in a garage where the mechanic began inspecting fittings on top of the tank and tightening fittings.
- The mechanic informed us that he needed to wait for the tank to cool down, so he
 was using that time to inspect the tank and look for any obvious problems.
- Initial retest resulted in a passing value for the pressure integrity.
- Initial retest of the internal vapor valves resulted in a passing value; however the retest was not conducted properly, as recognized by the mechanic.
- Subsequent retest of the internal vapor valves, by the facility mechanic, using the proper method showed a failure to the leak standard.
- Repairs consisted of determining which valve was leaking and replacement of that valve.
- Final 204.1 test showed compliance with all leak standards.
- Additionally, one other cargo tank trailer that had received a NOV that day at the Shell terminal arrived at the same repair facility (we did not observe the route or GDF delivery).
- The driver was instructed to return to the terminal for a partial load of diesel.
- The trailer was returned to the repair facility and retested by the facility mechanic.
- The internal vapor valves did not pass the leak integrity standard.
- No repairs were conducted at that time due to lack of available replacement parts.

September 5, 2007 – Vinvale, BP West Coast Products Terminal

- One violation, delivery route, and return to the repair facility was observed. Repair and retest was not observed.
- A NOV for failure of internal vapor valves to meet the leak standard was issued.
- The truck was followed to the Woodland Hills area and product delivery was observed.
- The truck was followed back to the repair facility where they determined that they
 could not perform repairs because they needed to degas the tank first and they did
 not have the equipment for degassing.
- The driver was instructed to go to a neighboring facility. The truck was followed to this facility where they also determined that they could not do the repair because they did not have degassing equipment.

- The driver was then instructed to take the truck to yet another facility, which did have degassing equipment.
- The truck was then followed to the third repair facility which had a carbon bed system for degassing.
- This facility could not accommodate repairs at that time and planned to do the degassing, repair and retest sometime in the next day or two. This concluded our observations for this truck.
- The test form returned to ARB by the repair shop identified maintenance was necessary to bring the tank back into compliance.

September 6, 2007 – East Hynes, BP Terminal

- Two violations, delivery routes, and returns to the repair facility were observed. Repairs and retests were not observed.
- A NOV for failure of the pressure integrity standard was issued.
- The truck was followed to the east Los Angeles area and product delivery was observed. There was no repair attempt during this time.
- The truck was then followed to the repair facility.
- The driver was instructed to return to the terminal for a load of diesel for the purposes of degassing before repair could be performed. The repair and retest would be scheduled for another day due to the current workload.
- The truck was followed back to the terminal. This concluded observations for this truck.
- A NOV for failure of the pressure integrity standard, as well as a liquid leak, was issued to the truck.
- The truck was followed to the Hawthorne area and product delivery was observed.
 There was no repair attempt during this time. A hissing sound was observed emanating from the top of the semi trailer during delivery.
- Following the delivery at the GDF, the cargo tank returned to the repair facility.
- At the repair facility, the driver was told that they could not perform repairs unless the tank was "diesel wet," i.e. the last load must be diesel for the purpose of degassing.
- At this point the driver contacted his employer who instructed him to return to their depot in Richmond, where he was to leave the truck parked for time being. This concluded observations for this truck.

October 16, 2007 - San Jose, Kinder Morgan Terminal

- There were no violations observed.
- On at least three occasions, during operation of the internal vapor valves in the commission of the test, a lack of pneumatic pressure prevented the internal vapor valves from operating. On these occasions, the truck was restarted and idled until sufficient pneumatic pressure was restored.

October 17, 2007 - San Jose, Chevron Terminal

- There were two violations observed.
- A NOV was issued for failure to meet the internal vapor valve leak standard on a truck's cargo tank.
- An appointment was made to observe the re-test and repair later that day at their facility nearby in San Jose. The truck was not followed.
- Although not observed by MLD staff, the mechanic stated that prior to our arrival at the repair facility the mechanic opened the hatch and inspected the seal with the internal vapor valve in the open position prior to conducting any tests.
- The internal vapor valve was then shown not to be leaking over the standard.
- Subsequently (30 minutes later), MLD staff conducted a visual inspection of the valve in operation and the valve was observed to "stick" in the open position and would not close. The facility mechanic also observed this and agreed he would change the valve.
- A second NOV was issued for failure to meet the internal vapor valve leak standard on a semi truck's trailer.
- The driver was instructed by his supervisors to make his delivery and go to the repair facility in Oakland for repair and re-test.
- MLD staff brought up the subject of degassing in an attempt to determine if they
 would return for a diesel load.
- The driver's supervisor said they had done this before and the repair facility must do some sort of "blow down."
- The truck was followed to the GDF delivery and then to the designated repair facility.
- At this facility, the mechanic stated he could not conduct the re-test and repairs because the tank contained gasoline vapors, and needed a load of diesel first.
- The driver contacted his supervisors and was dispatched back to his yard in Gilroy.
- There were no further observations for this tank.
- The test form returned to ARB by the repair shop identified maintenance was necessary to bring the tank back into compliance.

October 30, 2007 – Eureka, Chevron Terminal

- One violation was observed.
- A NOV was issued for failure to meet the internal vapor valve leak standard on the trailer.
- Upon return from making its diesel delivery, the cargo tank was removed from service and parked at the repair facility located in Eureka, near the terminal of origin. An appointment was made with a mobile, out of town testing company to meet the mechanic later that day.

- MLD staff observed the re-test and the internal vapor valve was still leaking (failed test) at the repair facility, prior to repair.
- The independent tester located the leak and removed the valve for rebuilding efforts.

November 14, 2007 – Bakersfield, Big West Terminal

- One violation was observed. Repair and retest was not observed.
- A NOV for failure of internal vapor valves to meet the leak standard was issued.
- The truck was followed to the local repair facility where the manager indicated that the delivery, subsequent diesel load, and repairs would be conducted the following day.
- The following morning, the manager indicated they were planning to do diesel loads for the entire day and repair would be delayed because the re-test and repair facility was busy at the time. This concluded our observations for this truck.

November 15, 2007 – Fresno, Kinder Morgan Terminal

- Two violations and one repair and re-test were observed.
- A NOV for failure of the pressure integrity standard was issued.
- The truck was met the next day at the repair facility.
- A defective gasket was replaced on one of the dome lids.
- Subsequent re-test met the standards.
- A NOV for failure of the pressure integrity standard was issued.
- The truck was met the following day at the repair facility.
- A defective dome lid seal was observed. However, because the tank contained gasoline vapors, repair was delayed until a diesel load could be arranged for proper degassing and subsequent repair and re-test. This concluded observations for this truck.

V. <u>DISCUSSION OF RESULTS</u>

As shown in Table 1 and Figure 1, most of the failures were due to leaking internal vapor valves. As discussed previously, only one of the cargo tanks was issued a NOV for a leak that was not subsequently detected back at the repair facility prior to any repairs. Thus, the issues of concern by industry were, for the most part, not observed in this study. However, as discussed in the conclusions below, we did observe several situations which may explain why the frequency is perceived by industry to be higher than what was observed in this study.

Also apparent from our observations is that there is a lack of conformity in the application of TP-204.1 between repair facilities. A big part of this is the issue of degassing, a requirement for TP-204.1, which repair facilities did not always understand was necessary. Several times we were unable to observe repairs because trucks were driven from the

gasoline delivery site directly to the repair facility, which had no mechanism for proper degassing.

VI. CONCLUSIONS

Based on the observations and results of the survey, the anomalous results of concern with test procedures used to determine compliance of cargo tanks could not be verified. The issues listed below were understood to be those of concern to CIOMA members. Although we did not observe a significant number of these anomalous cases, the few that were encountered provided possible explanations for assumed or perceived inconsistencies between loading rack results obtained by ED inspectors and those obtained by mechanics at repair facilities. Overall, there are two main conclusions.

- 1. The main "daily" or "rack test" conducted according to TP-204.2 is *designed* to be less stringent than the "annual" test, TP-204.1 and CP-204, which are the procedures conducted at the repair facility following issuance of a NOV at the rack.
- 2. Additionally, some key components may operate intermittently due to various reasons including design, road vibration, and maintenance.

Regarding the specific concerns raised by CIOMA and other industry representatives, the following is an issue by issue response based on the results of our observations during this study. Additionally, we present possible explanations for circumstances we did not directly observe:

Issue 1: Tank fails pressure test at the rack, but passes at the repair facility.

Observed reasons:

Repairs were made prior to re-test at repair facility. In one case, a mechanic met the driver at the GDF, climbed on top of the tank, and closed an open cam lock cap. In another case, a pinched gasket was detected and replaced by the operator before bringing the tank to a third-party repair facility.

Other possible explanations:

The P/V vent can operate intermittently due to road vibrations or debris. Unobserved repairs may be performed prior to test at the repair facility. Opening and closing of dome lid prior to test at repair facility may reseat the dome lid gasket.

Issue 2: Tank fails internal vapor valve test at rack, but passes at repair facility.

Observed reasons:

Internal vapor valves can operate intermittently, seemingly fine one cycle and failing the next (e.g. sticking in open position).

Other possible explanations:

Degassing with a diesel load may lubricate shaft and/or seals of the internal vapor valve. Also, Unobserved repairs may have been conducted prior to test at repair facility. Another

possibility is that opening and closing the Internal Vapor Valve may re-seat (i.e. close) the valve prior to test at repair facility.

Issue 3: Tank passes pressure test at rack, but fails during annual recertification.

Observed reasons:

None. This situation was not encountered. This would require using the 48-hour notification system and comparing with recent inspection records.

Other possible explanations:

The Annual test is designed to be more stringent. Furthermore, leaks/failures can occur at any time, such as between a rack inspection and the annual test. Additionally, small leaks below the liquid line may not have been detected at the rack due to the product in the tank. Another possibility is that the truck and trailer are not both always tested and one may meet the standards at the rack while the other is later shown to have a leak during annual certification.

Issue 4: Nominal volumes (cargo hold labels) are used by Enforcement staff to calculate ullage, instead of actual volumes.

Explanation:

The error associated with this problem is, by design, in favor of compliance at the rack because actual volumes are always larger than nominal volumes. Thus the allowed final pressure is less stringent, because the ullage is assumed to be smaller than actual.

Issue 5: Test procedures have biases. Specifically mentioned were percent sunlight on tank, previous cargo, and temperature change effects on pressure.

Explanation:

All "biases" are factored into the test procedures to ensure that TP-204.2, conducted at the rack will be less stringent (tend toward compliance) than TP-204.1, conducted at the repair facility.

VII. RECOMMENDATIONS

Based on the results and observations discussed above, the following is recommended:

- 1. The test procedures should continue to be implemented according to current operating procedures.
- A standardized training and certification program should be implemented for, and in cooperation with, owner/operators, mechanics, or any other independent contractor that conducts TP-204.1, the annual certification test. To verify conformity with TP-204.1, ARB should consider increasing the number of observed annual certification tests using the 48-hour notification system.

- 3. ARB should implement a program, in cooperation with industry, to test problematic equipment at parts houses. This has been done for pressure/vacuum vent valves, but should also include internal vapor valves, as they apparently represent a greater number of violations at this time.
- 4. The issue of degassing (removing gasoline vapors prior to repair and retesting activities) is in need of evaluation. The various methods of degassing could have significantly different resulting emissions. This operation should be closely examined to determine current industry practices and alternatives available. This would also require the assistance and participation of industry.